

RESEARCH ARTICLE

Deconstructing the Alcohol Harm Paradox: A Population Based Survey of Adults in England

Emma Beard^{1,2*}, Jamie Brown^{1,2}, Robert West², Colin Angus³, Alan Brennan³, John Holmes³, Eileen Kaner⁴, Petra Meier³, Susan Michie¹

1 Research Department of Clinical, Educational and Health Psychology, University College London, London, United Kingdom, **2** Department of Epidemiology and Public Health, University College London, London, United Kingdom, **3** ScHARR, School of Health and Related Research, University of Sheffield, Sheffield, United Kingdom, **4** Institute of Health & Society, Newcastle University, Newcastle, United Kingdom

* Current address: Cancer Research UK Health Behaviour Research Centre, University College London, London, United Kingdom

* e.beard@ucl.ac.uk



CrossMark
click for updates

Abstract

OPEN ACCESS

Citation: Beard E, Brown J, West R, Angus C, Brennan A, Holmes J, et al. (2016) Deconstructing the Alcohol Harm Paradox: A Population Based Survey of Adults in England. PLoS ONE 11(9): e0160666. doi:10.1371/journal.pone.0160666

Editor: Massimo Ciccozzi, National Institute of Health, ITALY

Received: May 11, 2016

Accepted: July 23, 2016

Published: September 28, 2016

Copyright: © 2016 Beard et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Data Availability Statement: The dataset is available at: <https://osf.io/abuhr/>. For further details please contact the lead author or Dr Jamie Brown (Jamie.Brown@ucl.ac.uk).

Funding: The National Institute for Health Research (NIHR) School for Public Health Research (SPHR) primarily funded data collection for the Alcohol Toolkit Study (SPHR-SWP-ALC-WP5). SPHR is a partnership between the Universities of Sheffield; Bristol; Cambridge; Exeter; UCL; The London School for Hygiene and Tropical Medicine; the LiLaC collaboration between the Universities of Liverpool and Lancaster and Fuse; The Centre for Translational

Background

The Alcohol Harm Paradox refers to observations that lower socioeconomic status (SES) groups consume less alcohol but experience more alcohol-related problems. However, SES is a complex concept and its observed relationship to social problems often depends on how it is measured and the demographic groups studied. Thus this study assessed socioeconomic patterning of alcohol consumption and related harm using multiple measures of SES and examined moderation of this patterning by gender and age.

Method

Data were used from the Alcohol Toolkit Study between March and September 2015 on 31,878 adults (16+) living in England. Participants completed the AUDIT which includes alcohol consumption, harm and dependence modules. SES was measured via qualifications, employment, home and car ownership, income and social-grade, plus a composite of these measures. The composite score was coded such that higher scores reflected greater social-disadvantage.

Results

We observed the Alcohol Harm Paradox for the composite SES measure, with a linear negative relationship between SES and AUDIT-Consumption scores ($\beta = -0.036$, $p < 0.001$) and a positive relationship between lower SES and AUDIT-Harm ($\beta = 0.022$, $p < 0.001$) and AUDIT-Dependence ($\beta = 0.024$, $p < 0.001$) scores. Individual measures of SES displayed different, and non-linear, relationships with AUDIT modules. For example, social-grade and income had a u-shaped relationship with AUDIT-Consumption scores while education had an inverse u-shaped relationship. Almost all measures displayed an exponential relationship with AUDIT-Dependence and AUDIT-Harm scores. We identified moderating effects from age and gender, with AUDIT-Dependence scores increasing more steeply with lower

Research in Public Health, a collaboration between Newcastle, Durham, Northumbria, Sunderland and Teesside Universities. EB's and SM's salaries are funded by the NIHR SPHR. EB is also funded by Cancer Research UK (CRUK; C1417/A14135). JB is funded by the Society for the Study of Addiction and CRUK also provide support (C1417/A14135); RW is funded by CRUK (C1417/A14135). EB and JB have both received unrestricted research funding from Pfizer relating to smoking cessation. RW has received travel funds and hospitality from, and undertaken research and consultancy for, pharmaceutical companies that manufacture and/or research products aimed at helping smokers to stop. EK is funded by the NIHR School of Primary Care Research. CA is funded by SPHR. CA, PM and JH have received funding related to commissioned research from Systembolaget, the Swedish government-owned alcohol retail monopoly. PM is a Scientific Advisor to the Institute for Alcohol Studies (IAS), for which she receives a personal fee. This does not alter the authors' adherence to PLOS ONE policies on sharing data and materials.

Competing Interests: EB's and SM's salaries are funded by the NIHR SPHR. EB is also funded by Cancer Research UK (CRUK). JB is funded by CRUK and the Society for the Study of Addiction; RW is funded by CRUK. EB and JB have both received unrestricted research funding from Pfizer, including for the Smoking Toolkit Study (a sister survey of the ATS). RW has received travel funds and hospitality from, and undertaken research and consultancy for, pharmaceutical companies that manufacture and/or research products aimed at helping smokers to stop. This does not alter the authors' adherence to PLOS ONE policies on sharing data and materials.

SES in men and both AUDIT-Harm and AUDIT-Dependence scores increasing more steeply with lower SES in younger age groups.

Conclusion

Different SES measures appear to influence whether the Alcohol Harm Paradox is observed as a linear trend across SES groups or a phenomenon associated particularly with the most disadvantaged. The paradox also appears more concentrated in men and younger age groups.

Introduction

Around 9.1 million adults in England drink alcohol above recommended limits, which leads to a wide range of health and social issues, from dangerous driving to crime, cancer and domestic abuse [1, 2]. The 2014 World Health Organisation's global status report estimated that 5.9% of all global deaths and 5.1% of the global burden of disease and injury is attributable to alcohol each year [3]. Despite those of higher SES being more likely to report engagement in hazardous levels of drinking, these health and social issues disproportionately affect the most deprived communities [4–19]. This phenomenon, whereby alcohol consumption tends to be higher in people of higher socio-economic status (SES), while levels of alcohol-related problems are greater in people of lower SES, has been coined the Alcohol Harm Paradox [4, 5]. Understanding what underlies this phenomenon requires more information on whether it is observable across different markers of SES and if it is moderated by other demographic variables including age and gender [4, 5, 20].

Elucidating the association between different SES measures and alcohol harm may help to identify possible causes of the Alcohol Harm Paradox by pinning down its underlying mechanisms. At the same time, the identification of measures by which the Alcohol Harm Paradox consistently emerges will be of interest to those planning studies on the association between SES and alcohol-related problems. Although it is important to choose a valid and reliable measure of SES, it is equally important to select one which captures the phenomenon of interest. One way researchers have addressed this issue is by use of composite scores which have been argued to reflect the multifaceted nature of SES i.e. both the human, social and material capital aspects [21, 22]. However, due to costs and logistical constraints it is often not possible to use a wide range of measures, and so it is important to form a consensus on which are the optimal choices [23]. It is also important to determine whether the Alcohol Harm Paradox differs as a function of socio-demographics, with previous studies hinting towards the Alcohol Harm Paradox being more pronounced among younger adults [19, 24–28] and men [29]. This will help target interventions and policies aimed at driving down inequalities in health.

The Alcohol Use Disorders Identification Test (AUDIT) [30] affords the ability to address these issues. The AUDIT combines scores on self-reported answers to questions regarding injuries to oneself or others; the need to drink first thing in the morning; feelings of remorse and guilt; an inability to stop drinking; concerns raised by friends, family and health-care professions; being unable to do what one would normally do; and episodes of alcohol induced amnesia. The AUDIT also includes a consumption measure which assesses frequency and quantity of usual drinking, as well as frequency of 'binge' drinking. Previous studies have

found that overall scores on the AUDIT are higher among those of lower SES, even though consumption scores tend to be lower or the same; indicating more harmful, hazardous, and potentially dependent, levels of drinking [29, 31–33].

Although objective measures of harm are available (e.g., alcohol-related mortality, morbidities and hospital admissions), these have a tendency to underestimate the true impact. For example, alcohol-related deaths only apply to those for which alcohol was the main contributor [34]. Other issues arise in terms of attributing admissions and illnesses to alcohol and in attaching such measures to an individual of a particular SES. The AUDIT also benefits from allowing a wider assessment of harms that are less amenable to objective measurement [9], which in themselves have been found to be predictive of future acute events and offer an opportunity for early intervention [35, 36].

In summary, this paper aimed to:

1. Identify the Alcohol Harm Paradox in a population sample of adults in England by assessing the association between a composite measure of SES and: a) Drinking status and b) AUDIT measures: i) Alcohol consumption (AUDIT-C), ii) Alcohol-related harm (AUDIT-Harm) and iii) an Alcohol-dependence indicator (AUDIT-Dependence).
2. Assess whether the Alcohol Harm Paradox exists across different measures of SES, and if the pattern of association is similar for these individual measures (i.e. linear or non-linear), by assessing the association between social-grade, housing tenure, car ownership, qualifications, income and employment status and: a) Drinking status and b) AUDIT measures: AUDIT-C, ii) AUDIT-Harm and iii) AUDIT-Dependence.
3. Assess whether the Alcohol Harm Paradox is moderated by demographic characteristics by assessing the association between an interaction of the composite score of SES with gender and age and AUDIT measures: i) AUDIT measures: AUDIT-C, ii) AUDIT-Harm and iii) AUDIT-Dependence.

All analyses were adjusted for gender, age, ethnicity and alcohol consumption, given that alcohol use varies as a function of demographic characteristics and as differences in drinking patterns may be one causal explanation for the Alcohol Harm Paradox [5, 37]. This is the first study, to our knowledge, which has investigated the Alcohol Harm Paradox in a large population sample of adults in England using multiple measures of SES, and its moderation by demographic characteristics.

Methodology

Ethical approval

Ethics approval for the Smoking Toolkit Study (STS), a sister survey to the Alcohol Toolkit Study (ATS), was originally granted by the UCL Ethics Committee (ID 0498/001). Approval for the ATS was granted by the same committee as an extension of the STS. The data are not collected by UCL and are anonymised when received by UCL. Explicit verbal agreement and willingness to answer questions voluntarily is recorded electrically by Ipsos Mori, the company administering the survey. This is standard protocol and was agreed by the UCL ethics committee. Participants are also given a printed information sheet.

Design

Data were used from the ATS (www.alcoholinengland.info). The sample comprised of all those taking part between March 2014 and September 2015 (the period for which data were

available). The ATS involves monthly cross-sectional household computer-assisted interviews, conducted by Ipsos Mori of approximately 1,700 adults aged 16+ and over in England. The baseline survey uses a type of random location sampling, which is a hybrid between random probability and simple quota sampling [38]. Participants from the STS appear to be representative of the population in England, having similar socio-demographic composition and smoking characteristics to large national surveys based on probability samples such as the Health Survey for England [17]. STROBE reporting guidelines were followed throughout [39].

Measures

Data were collected on participant's age, gender, ethnicity and SES. Six measures of SES were collected which are outlined below.

1. Social-grade was measured using the British National Readership Survey (NRS) Social-Grade Classification Tool [40].
2. Annual income in 15 bands (Up to £4499; £4,500–6,499; £6500–7499; £7500–£9499; £9500–11499; £11500–£13499; £13500–15499; £15500–17499; £17500–24999; £25000–29999; £30000–39999; £40000–49999; £50000–74999; £75000–£99999; > £100000).
3. Educational level in 8 categories (GCSE/O-level/CSE; vocational qualification; A-level or equivalent; Bachelor degree or equivalent; Masters/PHD or equivalent; other; no formal qualifications; still studying)
4. Car ownership (owns a car; does not own a car)
5. Working status in 7 categories (Have paid job (full time); have a paid job (part time and over or under 8 hours per week); self-employed; full-time student; still at school; retired; not in paid work (long term illness, housewife or other reason))
6. Housing tenure in 6 categories (mortgage, owned outright, rented from local authority, rented from private landlord, belongs to housing association and other).

All variables, except social-grade, were then dichotomised or categorised as follows (all variables were coded so that lower SES reflected higher scores): 1) Income: £40,000 +, £17,500 to £39,999, £11,500 to £17,499, < £11,499, per annum; 2) Education: University education, A-level and equivalent, GCSE/vocational, other/still studying, none; 3) Car ownership: Owns a car versus does not own a car; 4) Working status: Full time job versus no full time job; and 5) Housing tenure: owner occupied (owned outright or being brought with a mortgage) versus other. These thresholds were based on previous research and characterisations: income was categorised into quartiles, with the cut-off of £11,499 being the closest equivalent to the UK definition of poverty of 60% of median national household income [41]. Educational categories, home ownership and full time employment have also been previously used (e.g., [42, 43]).

A composite score was also derived to reflect the multidimensional nature of SES. Composite scores have the advantage of reducing measurement error present in single items and improving ease of reporting and interpretation [21, 44]. The composite score was coded such that a higher composite score measure reflected greater social-disadvantage.

Finally, participants completed the 10-item AUDIT [45]. Questions 1–3 deal with alcohol consumption, 4–6 with alcohol dependence and 7–10 with alcohol-related harm. Previous

research suggests these three AUDIT dimensions provide sensitive and coherent measures of alcohol consumption, harm and dependence [45, 46].

Analysis

All analyses were conducted in R version 3.1.2. Percentages of missing values for the predictor variables of interest were as follows: gender = 0%, age = 0%, social-grade = 0%, ethnicity = 0.5%, home ownership = 1.0%, full time work = 0.3%, income = 42.8%, car ownership = 1.2%. Missing data for the 10 items of the AUDIT ranged from 0.1 to 0.8%. Missing data were imputed by multiple imputation using the Amelia 11 package [47]. Little's test suggested that income data may not have been missing at random [48]. The number of imputed data sets was set to 20 [49] and results combined using Rubin's Rules [50].

A SES composite score, based on all 6 measures of SES, was derived using Multiple Correspondence Analysis (MCA) applied using the FactoMineR package [51]. Weights for the composite score comprised of those for the first three components; the assumption being that the variation explained by these is sufficient to adequately represent the original values [52].

The analysis proceeded as follows:

1. Sample characteristics
Data were weighted for important prevalence statistics using the "Survey" R package [53], in order to match the population in England. Generalised Linear Models (GLM), specifying the quasi-binomial distribution, were used to assess the association between socio-demographic characteristics and abstinence/alcohol use.
2. Identifying the Alcohol Harm Paradox
Separate GLMs, specifying the Gaussian family, were run to assess the associations between the composite measure and AUDIT dimension scores. Associations with AUDIT-C, AUDIT-Harm and AUDIT-Dependence were only assessed among those who reported alcohol consumption. All analyses were adjusted for age, gender and ethnicity (and alcohol consumption when assessing AUDIT-Harm and AUDIT-Dependence). The associations between the SES measures and each of its 10 component scales were also assessed in sensitivity analyses (see [S1 Table](#)).
3. Does the Alcohol Harm Paradox exist across different measures of SES?
In order to assess whether the composite score suitably reflected the associations between the individual SES measures and the outcomes of interest, additional models were run which regressed the 6 individual SES measures onto the residuals of the fully adjusted models. Lack of association would suggest that the residual variance is simply noise, while significant relationships would suggest that the individual items may explain additional patterns in AUDIT dimension scores and drinking status not captured by the composite measure. Further GLMs were then run to assess the association between these individual measures and the three AUDIT dimension scores.
4. Is the Alcohol Harm Paradox moderated by demographic characteristics?
Possible moderation effects of gender and age were assessed by including interaction terms in the GLM models. Moderation effects were only assessed for the composite score due to ease of reporting, as it aims to reflect the multifaceted nature of SES, had the most consistent relationships with the ten questions of the AUDIT (see [S1 Table](#)), and is less susceptible to measurement error [21].

For all analyses, age was categorised as the assumptions of linearity and linearity of the logit were violated.

Table 1. Demographic characteristics overall and as a function of drinking status (Drinker versus Non-Drinker).

	All participants (n = 31,878)	Non-Drinkers (n = 10339)	Drinkers (n = 21539)	OR (95%CI) unadjusted
Gender % (n)				
Male	51.1 (16279)	45.9 (4748)	53.5 (11531)	Reference
Female	48.9 (15599)	54.1 (5591)	46.5 (10008)	0.74 (0.70 to 0.77)***
Age % (n)				
16–24	16.0 (5092)	18.2 (1879)	14.9 (3113)	Reference
25–34	15.4 (4917)	19.2 (1983)	13.6 (2934)	0.87 (0.80 to 0.94)***
35–44	14.6 (4646)	15.9 (1647)	13.9 (2999)	1.06 (0.98 to 1.16)
45–54	15.1 (4816)	12.7 (1315)	16.3 (3501)	1.56 (1.43 to 1.70)***
55–64	15.0 (4792)	12.1 (1249)	16.4 (3543)	1.66 (1.52 to 1.81)***
65+	23.9 (7615)	21.9 (2266)	24.8 (5349)	1.38 (1.28 to 1.49)***
Ethnicity % (n)				
White	83.2 (26028)	61.3 (6344)	92.9 (20001)	Reference
Non-white	16.8 (5333)	38.7 (4008)	7.07 (1525)	0.12 (0.11 to 0.13)***

Note:

*** significant difference $p < 0.001$.

doi:10.1371/journal.pone.0160666.t001

Results

Sample characteristics

Data were collected on 31,878 participants between March 2014 and September 2015. Sixty-eight per cent of participants reported that they drank alcohol (95%CI 67.0 to 68.1; $n = 21539$; Weighted = 70.7, 95%CI 70.2 to 71.2, $n = 22538$). Table 1 shows the demographic characteristics of participants overall and as a function of their drinking status. Women and those of non-white ethnicity had lower odds of consuming alcohol; while those of an older age were more likely to report that they drank than those aged 16–24.

Identifying the Alcohol Harm Paradox

The composite score was derived using the weights from the MCA given in Table 2. The derived composite score was found to have good internal consistency (standardised Cronbach alpha of: 0.64). Reliability decreased when SES measures were dropped, with the greatest decline being the exclusion of social-grade (Cronbach alpha to 0.53).

Table 3 shows the results of the linear regression analyses assessing the association between the composite score with drinking status and the three AUDIT dimensions. Those with higher composite scores had lower odds of drinking alcohol compared to those with lower composite scores (non-drinkers composite score: $M = 12.5$, $SD \pm 3.93$; drinkers composite score: $M = 10.5$,

Table 2. ETA squared values (weights) for the dimensions of the composite score.

Dimension	Eta squared
Home ownership	0.406
Full time work	0.453
Income	0.878
+16 Education	1.167
Car ownership	0.186
Social-grade	1.631

doi:10.1371/journal.pone.0160666.t002

Table 3. Association between the composite SES score with drinking status and the three dimensions of the AUDIT.

	Adjustment	Drinkers versus non-drinkers	AUDIT-C	AUDIT-Harm	AUDIT-Dependence
		OR (95%CI) <i>p</i>	β (95%CI) <i>p</i>	β (95%CI) <i>p</i>	β (95%CI) <i>p</i>
Model 1	None	0.873 (0.867 to 0.879) 0.001	-0.050 (-0.059 to -0.041) 0.001	0.011 (0.005 to 0.016) 0.001	0.018 (0.015 to 0.021) 0.001
Model 2	Gender, age & ethnicity	0.862 (0.856 to 0.869) 0.001	-0.036 (-0.045 to -0.027) 0.001	0.013 (0.008 to 0.019) 0.001	0.020 (0.017 to 0.023) 0.001
Model 3	+ AUDIT-C			0.022 (0.017 to 0.027) 0.001	0.024 (0.021 to 0.027) 0.001

Note: NA = Not applicable; composite score was mean centred

doi:10.1371/journal.pone.0160666.t003

SD \pm 3.72). In the fully adjusted models, increasing social-disadvantage was positively associated with both AUDIT-Harm and AUDIT-Dependence scores.

Does the Alcohol Harm Paradox exist across different measures of SES?

The results of the residual analyses, whereby the 6 individual SES measures were regressed onto the residuals of the fully adjusted models in [Table 3](#), are given in [Table 4](#). Although it appears that the majority of residual variance may be noise for drinking status and AUDIT-C, significant relationships between some of the SES measures and residuals, particularly education and social-grade, were found for AUDIT-Dependence and AUDIT-Harm. This suggests that some non-linear associations between the various SES measures and AUDIT-Dimensions may exist.

[Table 5](#) shows the association between the individual measures of SES and drinking status (i.e. drinker versus non-drinker). In the adjusted analyses, the odds of being a drinker decreased linearly with decreasing social-grade, income and educational attainments. Those who did not own a car, did not own their own home, and were not in full time work, also had lower odds of reporting that they drank alcohol.

[Table 6](#) shows the average AUDIT-C scores as a function of the various SES measures and the results of the regression analysis assessing whether SES was a significant predictor of consumption. Although all social-grades and incomes had lower AUDIT-C scores relative to the reference categories AB and >£40,000, the relationship was U-shaped. In contrast, the relationship with education was linear whereby AUDIT-C scores decreased with increasingly fewer qualifications. Lower AUDIT-C scores were also found among those not in full-time work. The findings were inconclusive as to whether or not an association was present with car and home ownership.

Tables [7](#) and [8](#) show the average AUDIT-Harm and AUDIT-Dependence scores as a function of the various SES measures; and the results of the regression analysis assessing whether SES is a significant predictor of alcohol-related harm and dependence. For income, education and social-grade, AUDIT-Harm scores were largest in the most disadvantaged groups (i.e. <£11,499, no qualifications and E), with a number of non-significant associations for less disadvantaged groups. Those who did not own their own home and were not in full time work also had higher AUDIT-Harm scores. The findings were inconclusive as to whether or not an association was present with car ownership.

Non-linear relationships were found between education and social-grade with AUDIT-Dependence scores. Although lower scores were found among all social-grades relative to AB and educational attainments relative to having a university qualification, similar scores were found

Table 4. Association between the individual SES measures and residuals of the adjusted models assessing the association between the composite score with drinking and the three AUDIT dimensions with adjustment for composite scores.

	Drinkers versus non-drinkers	AUDIT-C	AUDIT-Harm	AUDIT-Dependence
	β (95%CI)	β (95%CI)	β (95%CI)	β (95%CI)
Social-grade %(n)				
AB	Reference	Reference	Reference	Reference
C1	0.09 (-0.01 to 0.18)	-0.09 (-0.19 to 0.01)	-0.03 (-0.09 to 0.02)	-0.04 (-0.07 to <0.01)*
C2	0.15 (0.03 to 0.27) *	-0.10 (-0.23 to 0.03)	-0.15 (-0.22 to -0.08)***	-0.05 (-0.10 to <-0.01)*
D	0.05 (-0.01 to 0.21)	-0.26 (-0.43 to -0.08)**	-0.17 (-0.26 to -0.07)**	-0.10 (-0.16 to -0.04)**
E	0.26 (0.07 to 0.45) **	0.18 (-0.04 to 0.40)	0.03 (-0.10 to 0.15)	0.08 (<-0.01 to 0.15)
Home ownership %(n)				
Yes	Reference	Reference	Reference	Reference
No	-0.01 (-0.17 to -0.04) ***	0.17 (0.1 to 0.24)***	0.12 (0.08 to 0.16)***	0.07 (0.05 to 0.10)***
Income %(n)				
£40,000 +	Reference	Reference	Reference	Reference
£17,500 to £39,999	-0.02 (-0.11 to 0.06)	-0.22 (-0.32 to -0.12)***	0.04 (-0.01 to 0.09)	-0.01 (-0.04 to 0.02)
£9,500 to £17,499	-0.13 (-0.26 to <0.01)	-0.38 (-0.50 to -0.26)***	0.09 (0.02 to 0.15)*	0.02 (-0.03 to 0.07)
< £11,499	0.01 (-0.12 to 0.14)	-0.01 (-0.14 to 0.13)	0.28 (0.19 to 0.36)***	0.09 (0.04 to 0.14)***
Car ownership %(n)				
Yes	Reference	Reference	Reference	Reference
No	-0.01 (-0.07 to 0.05)	(<0.01 (-0.06 to 0.07)	0.04 (<0.01 to 0.08)*	0.05 (0.03 to 0.07)***
Education %(n)				
University	Reference	Reference	Reference	Reference
A-level and equivalent	0.14 (0.05 to 0.23) **	0.27 (0.17 to 0.37)***	-0.09 (-0.14 to -0.03)**	-0.05 (-0.08 to -0.01)***
GCSE/vocational	0.02 (-0.08 to 0.11)	0.08 (-0.03 to 0.18)	-0.16 (-0.22 to -0.01)***	-0.09 (-0.13 to -0.06)***
Other/still studying	0.14 (0.01 to 0.27) *	0.02 (-0.12 to 0.16)	-0.24 (-0.32 to -0.16)***	-0.12 (-0.17 to -0.07)***
None	-0.13 (-0.26 to 0.01)	<0.01 (-0.16 to 0.16)	-0.25 (-0.34 to -0.17)***	-0.12 (-0.18 to -0.07)***
Full time work %(n)				
Yes	Reference	Reference	Reference	Reference
No	0.10 (0.04 to 0.16) ***	0.24 (0.17 to 0.30)***	0.13 (0.09 to 0.17)***	0.06 (0.03 to 0.08)***

Note:

*significant difference $p<0.05$;

** significant difference $p<0.01$;

*** significant difference $p<0.001$

doi:10.1371/journal.pone.0160666.t004

amongst those of middle level SES, whilst the difference was greatest for those of the lowest SES. A linear association was noted with income, whereby decreasing income was associated with greater AUDIT-Dependence scores. Not owning a home or car and not being in full time work were also associated with greater dependency.

Is the Alcohol Harm Paradox moderated by demographic characteristics?

Table 9 shows the results of the moderation analysis. The coefficient for the composite score can be interpreted as the effect on AUDIT dimension measures when age and gender are equal to zero i.e. for those aged 16–24 years of age and males, respectively. The decrease in AUDIT-C and increase in AUDIT-Harm with greater social-disadvantage, as measured by the composite score, did not appear to be moderated by gender. In contrast, increasing AUDIT-Dependence scores with increasing social-disadvantage was found to be greatest among men.

Table 5. Socio-demographic characteristics and AUDIT dimension scores overall and as a function of drinking status (Drinker versus Non-Drinker).

	All participants (n = 31,878)	Non-Drinkers (n = 10339)	Drinkers (n = 21539)	OR (95%CI) unadjusted	OR (95%CI) adjusted for gender, age and ethnicity
Social-grade %(n)					
AB	21.0 (6692)	12.3 (1275)	25.1 (5417)	Reference	Reference
C1	30.7 (9798)	26.2 (2706)	32.9 (7092)	0.62 (0.57 to 0.66)***	0.68 (0.63 to 0.74)***
C2	21.0 (6704)	20.7 (2145)	21.2 (4559)	0.50 (0.46 to 0.54)***	0.49 (0.45 to 0.54)***
D	16.0 (5112)	23.3 (2404)	12.6 (2708)	0.27 (0.24 to 0.29)***	0.30 (0.27 to 0.33)***
E	11.2 (3572)	17.5 (1809)	8.2 (1763)	0.23 (0.21 to 0.25)***	0.24 (0.22 to 0.27)***
Home ownership % (n)					
Yes	59.7 (18502)	49.1 (5082)	65.6 (14126)	Reference	Reference
No	40.3 (12300)	50.9 (5270)	34.4 (7400)	0.51 (0.48 to 0.53)***	0.54 (0.51 to 0.57)***
Income %(n)					
£40,000 +	25.7 (8007)	18.2 (1881)	29.7 (6449)	Reference	Reference
£17,500 to £39,999	31.9 (9862)	28.6 (2959)	33.8 (7265)	0.72 (0.66 to 0.78)***	0.74 (0.68 to 0.80)***
£9,500 to £17,499	20.8 (6365)	25.3 (2619)	18.3 (3942)	0.44 (0.40 to 0.48)***	0.48 (0.43 to 0.53)***
< £11,499	21.6 (6569)	28.0 (2896)	18.0 (3868)	0.39 (0.36 to 0.43)***	0.41 (0.38 to 0.45)***
Car ownership %(n)					
Yes	33.1 (10567)	28.0 (2903)	35.6 (7663)	Reference	Reference
No	66.9 (21312)	72.0 (7449)	64.4 (13863)	0.71 (0.67 to 0.74)***	0.79 (0.74 to 0.83)***
Education %(n)					
University	27.4 (8723)	22.0 (2280)	29.9 (6443)	Reference	Reference
A-level and equivalent	18.1 (5778)	15.4 (1593)	19.4 (4185)	0.93 (0.86 to 1.00)	0.81 (0.75 to 0.89)***
GCSE/vocational	28.4 (9047)	28.5 (2955)	28.3 (6093)	0.73 (0.68 to 0.78)***	0.55 (0.51 to 0.59)***
Other/still studying	8.5 (2704)	8.4 (871)	8.5 (1833)	0.74 (0.68 to 0.82)***	0.53 (0.47 to 0.59)***
None	17.6 (5626)	25.6 (2653)	13.8 (2973)	0.40 (0.37 to 0.43)***	0.26 (0.24 to 0.29)***
Full time work %(n)					
Yes	47.4 (14621)	44.9 (4644)	48.8 (10502)	Reference	Reference
No	52.6 (16181)	55.1 (5707)	51.2 (11024)	0.85 (0.81 to 0.91)***	0.72 (0.67 to 0.76)***

Note:

*** significant difference $p < 0.001$.

doi:10.1371/journal.pone.0160666.t005

Interactions were also found between the three AUDIT dimensions and age. The findings were inconclusive as to whether or not social-disadvantage was associated with AUDIT-C scores among younger age groups. In contrast, those aged 65+ were found to have lower scores with increasing social-disadvantage. AUDIT-Harm scores increased with decreasing SES among all age groups, except among those aged 55–64 where no association was found and those and 65+ in which higher composite scores were associated with lower harm scores. Higher AUDIT-Dependence scores were found with increasing composite scores among all age groups, with the strongest association in younger age groups.

Discussion

The Alcohol Harm Paradox emerged for a composite measure of SES. However, several SES indices showed additional non-monotonic associations with AUDIT-C, AUDIT-Harm and AUDIT-Dependence dimensions. The association between AUDIT-Dependence scores and lower SES was stronger for men. Lower SES was only associated with lower AUDIT-C scores

Table 6. Association between measures of socio-economic status and AUDIT-C scores (drinkers only n = 21539).

	M	SD	Unadjusted			Adjusted for gender, age and ethnicity		
			β	95%CI	p	β	95%CI	p
Social-grade								
AB	4.21	2.33	Reference			Reference		
C1	4.13	2.51	-0.08	-0.17 to 0.01	0.078	-0.19	-0.27 to -0.10	<0.001
C2	4.08	2.52	-0.13	-0.23 to -0.03	0.01	-0.28	-0.38 to -0.19	<0.001
D	3.81	2.65	-0.39	-0.51 to -0.28	<0.001	-0.52	-0.63 to -0.41	<0.001
E	4.04	2.85	-0.17	-0.31 to -0.03	0.014	-0.16	-0.29 to -0.03	0.013
Tenure								
Owens home	4.28	2.73	Reference			Reference		
Does not own home	3.99	2.4	0.3	0.23 to 0.37	<0.001	0.05	-0.02 to 0.12	0.188
Income								
£40,000 +	4.44	2.76	Reference			Reference		
£17,500 to £39,999	4.03	2.73	-0.4	-0.50 to -0.31	<0.001	-0.3	-0.39 to -0.20	<0.001
£9,500 to £17,499	3.68	2.77	-0.75	-0.87 to -0.64	<0.001	-0.51	-0.62 to -0.40	<0.001
< £11,499	4.03	3.01	-0.4	-0.52 to -0.28	<0.001	-0.2	-0.32 to -0.09	<0.001
Car								
Owens car	4.12	2.46	Reference			Reference		
Does not own car	4.07	2.56	-0.05	-0.12 to 0.02	0.163	-0.04	-0.11 to 0.03	0.240
Education								
University	4.1	2.31	Reference			Reference		
A-level and equivalent	4.54	2.7	-0.57	-0.68 to -0.46	<0.001	0.19	0.10 to 0.29	<0.001
GCSE/vocational	4.09	2.57	-0.01	-0.10 to 0.08	0.814	-0.08	-0.16 to 0.01	0.066
Other/still studying	3.94	2.44	-0.16	-0.29 to -0.03	0.019	-0.17	-0.30 to -0.05	0.006
None	3.53	2.55	-0.57	-0.68 to -0.46	<0.001	-0.32	-0.42 to -0.21	<0.001
Work								
Full time work	4.26	2.5	Reference			Reference		
Not in full time work	3.93	2.53	-0.33	-0.40 to -0.26	<0.001	0.2	0.13 to 0.28	<0.001

doi:10.1371/journal.pone.0160666.t006

among those aged 55+. Those aged 65+ also experienced less harm and dependence with decreasing SES than younger age groups.

Although these findings support the existence of the alcohol harm paradox, the presence of several monotonic relationships suggests that it may not work on a social gradient. Rather than running in a linear manner from top to bottom of the socioeconomic spectrum, it appears to be a phenomenon more of the very poorest. Previous studies have found wider differences in the proportion of individuals engaging in unhealthy behaviours between the bottom and top SES groups [54] and that alcohol-related harm is disproportionately experienced by the most deprived [55]. Although we adjusted for several demographic characteristics some of this non-linearity may be accounted for by other factors which are correlated with SES, including area level deprivation [56], access to treatment [4, 5] and marital status [57].

These results also suggest that the Alcohol Harm Paradox may be somewhat dependent on the measure of SES which is used. A number of studies have similarly failed to report strong associations between measures of consumption/harm and both educational qualifications and assets (e.g. home ownership and durables); while stronger relationships have been noted with income and employment status [15, 19, 31].

These findings have several implications. First they suggest that researchers should perhaps consider the measures of SES that have the most consistent linear relationship with measures

Table 7. Association between measures of socio-economic status and Audit-Harm scores (drinkers only n = 21539).

			Unadjusted			Adjusted for gender, ethnicity and age			Adjusted for gender, ethnicity, age and Audit-C		
	M	SD	β	95%CI	p	β	95%CI	p	β	95%CI	p
Social-grade											
AB	0.45	1.3	Reference			Reference			Reference		
C1	0.57	1.49	0.12	0.06 to 0.17	<0.001	0.01	-0.05 to 0.06	0.826	0.05	<0.01 to 0.10	0.035
C2	0.49	1.42	0.03	-0.03 to 0.09	0.284	-0.06	-0.12 to <0.01	0.041	0.01	-0.04 to 0.06	0.75
D	0.52	1.44	0.07	<0.01 to 0.14	0.044	-0.06	-0.12 to 0.01	0.09	0.07	0.01 to 0.13	0.031
E	0.82	2.02	0.37	0.29 to 0.45	<0.001	0.29	0.21 to 0.37	<0.001	0.33	0.26 to 0.40	<0.001
Tenure											
Owens home	0.39	1.22	Reference			Reference			Reference		
Does not own home	0.82	1.84	0.42	0.38 to 0.47	<0.001	0.21	0.17 to 0.26	<0.001	0.2	0.16 to 0.24	<0.001
Income											
£40,000 +	0.52	1.55	Reference			Reference			Reference		
£17,500 to £39,999	0.47	1.46	-0.05	-0.10 to 0.01	0.076	-0.02	-0.07 to 0.04	0.527	0.05	<0.01 to 0.10	0.043
£9,500 to £17,499	0.45	1.53	-0.06	-0.13 to <0.01	0.056	-0.01	-0.07 to 0.06	0.867	0.12	0.05 to 0.18	<0.001
< £11,499	0.78	2.16	0.26	0.19 to 0.34	<0.001	0.27	0.20 to 0.34	<0.001	0.32	0.25 to 0.39	<0.001
Car ownership											
Owens car	0.48	1.37	Reference			Reference			Reference		
Does not own car	0.57	1.55	0.1	0.05 to 0.14	<0.001	0.06	0.02 to 0.10	0.006	0.02	-0.01 to 0.06	0.178
Educational qualifications											
University	0.49	1.34	Reference			Reference			Reference		
A-level and equivalent	0.77	1.76	0.28	0.22 to 0.33	<0.001	0.07	0.02 to 0.13	0.012	0.03	-0.03 to 0.08	0.311
GCSE/vocational	0.55	1.53	0.06	0.01 to 0.11	0.02	0.01	-0.04 to 0.06	0.734	0.03	-0.02 to 0.07	0.243
Other/still studying	0.42	1.27	-0.07	-0.15 to <0.01	0.056	-0.06	-0.14 to 0.01	0.096	-0.02	-0.09 to 0.05	0.526
None	0.35	1.31	-0.14	-0.20 to -0.07	<0.001	0.01	-0.06 to 0.08	0.765	0.09	0.03 to 0.15	0.005
Employment status											
Full time work	0.55	1.42	Reference			Reference			Reference		
Not in full time work	0.53	1.53	-0.02	-0.06 to 0.02	0.296	0.27	0.22 to 0.31	<0.001	0.22	0.18 to 0.26	<0.001

doi:10.1371/journal.pone.0160666.t007

of alcohol consumption, harm and possible dependence (i.e. income), if they wish to decipher the mechanisms of the Alcohol Harm Paradox. However, this approach may be an over-simplification as no single measure entirely captures the multifaceted nature of SES [43]; thus one may wish instead to use a composite score, which also has the advantage of reducing the effects of measurement error [21]. Secondly, these findings may explain the previous failure of alcohol control policies aimed at tackling health inequalities. For example, educational messages have had relatively little effect in reducing differences in consumption rates [58]. Although, this is also likely to be a consequence of the provision of information and persuasion to reduce alcohol related harm occurring in an environment in which many competing messages are received in the form of marketing and social norms supporting drinking. In contrast, interventions which tackle affordability appear to be more fruitful. Research indicates that minimum unit pricing (MUP) would have a positive impact on reducing health inequalities, by targeting price increases on heavier drinkers in the lower SES groups who are at greatest risk of harm [59]. Thirdly, these findings may help to elucidate the mechanisms of the Alcohol Harm Paradox. The association with income would suggest a materialistic explanation, while associations with occupational characteristics suggest possible psychosocial links between socioeconomic status and health. Thus it may be the case that those of lower SES experience greater harm as they have less access to health-care resources and have more deprived living conditions [4, 5].

Table 8. Association between measures of socio-economic status and Audit-Dependence scores (drinkers only n = 21539).

			Unadjusted			Adjusted for gender and age			Adjusted for gender, age and Audit-C		
	M	SD	β	95%CI	<i>p</i>	β	95%CI	<i>p</i>	β	95%CI	<i>p</i>
Social-grade											
AB	0.13	0.61	Reference			Reference			Reference		
C1	0.19	0.72	0.06	0.03 to 0.09	<0.001	0.01	-0.02 to 0.04	0.39	0.03	<0.01 to 0.06	0.022
C2	0.22	0.86	0.09	0.06 to 0.12	<0.001	0.05	0.02 to 0.09	0.002	0.08	0.05 to 0.11	<0.001
D	0.22	0.87	0.09	0.05 to 0.13	<0.001	0.04	<0.01 to 0.08	0.066	0.09	0.06 to 0.13	<0.001
E	0.47	1.57	0.34	0.30 to 0.39	<0.001	0.31	0.26 to 0.36	<0.001	0.33	0.29 to 0.37	<0.001
Tenure											
Owens home	0.12	0.62	Reference			Reference			Reference		
Does not own home	0.37	1.17	0.24	0.22 to 0.27	<0.001	0.16	0.14 to 0.19	<0.001	0.16	0.13 to 0.18	<0.001
Income											
£40,000 +	0.18	0.89	Reference			Reference			Reference		
£17,500 to £39,999	0.16	0.88	-0.02	-0.06 to 0.02	0.275	<0.01	-0.04 to 0.03	0.876	0.03	-0.01 to 0.06	0.107
£9,500 to £17,499	0.2	0.96	0.02	-0.02 to 0.06	0.383	0.05	0.01 to 0.09	0.022	0.1	0.06 to 0.15	<0.001
< £11,499	0.36	1.34	0.18	0.14 to 0.22	<0.001	0.19	0.15 to 0.23	<0.001	0.21	0.17 to 0.25	<0.001
Car											
Owens car	0.15	0.68	Reference			Reference			Reference		
Does not own car	0.24	0.94	0.09	0.07 to 0.11	<0.001	0.07	0.05 to 0.10	<0.001	0.02	<0.01 to 0.04	0.048
Education											
University	0.16	0.69	Reference			Reference			Reference		
A-level and equivalent	0.29	0.94	0.13	0.10 to 0.17	<0.001	0.06	0.03 to 0.10	<0.001	0.04	0.01 to 0.07	0.013
GCSE/vocational	0.22	0.89	0.06	0.03 to 0.09	<0.001	0.05	0.02 to 0.08	0.001	0.06	0.03 to 0.09	<0.001
Other/still studying	0.18	0.75	0.02	-0.02 to 0.07	0.354	0.04	<0.01 to 0.09	0.061	0.06	0.02 to 0.10	0.004
None	0.2	1.03	0.04	0.01 to 0.08	0.025	0.12	0.09 to 0.16	<0.001	0.16	0.12 to 0.20	<0.001
Employment status											
Full time work	0.2	0.76	Reference			Reference			Reference		
Not in full time work	0.21	0.93	0.01	-0.01 to 0.04	0.245	0.15	0.13 to 0.18	<0.001	0.13	0.11 to 0.16	<0.001

doi:10.1371/journal.pone.0160666.t008

Previous studies have established that increasing social-disadvantage is associated with severity of dependence among men [27, 28]. There are numerous possible reasons for this: women tend to have a greater number of emotional supportive social relationships, which may protect against the consequences of being unemployed, being on a low income, lack of educational qualifications, and excessive alcohol use [60]. Alternatively, it could be the result of the type of beverage which is consumed or differences in drinking patterns and drinking occasions; or the gendered meaning of drinking [26, 61–63].

The finding that the association between alcohol dependency and SES diminished in older age groups, whilst the association between consumption and SES increased, is also consistent with previous findings [24, 25]; and suggests that the Alcohol Harm Paradox may be a phenomenon particularly associated with the young. A number of explanations for the Alcohol Harm Paradox have been put forward which may elucidate this moderation effect. One theory is that differences exist in drinking patterns, whereby those from lower SES consume a similar amount of alcohol per week but do so over a smaller number of days. Indeed, “binge drinking” culture is a particularly associated with young adults and lower SES groups [64, 65]. There could also be a confounding effect due to poly-behaviours such a poor diet and lack of exercise [66]; or perhaps those living in more deprived areas face greater barriers to accessing health services and alcohol interventions [19]. Such poly behaviours and poor help-seeking have been

Table 9. Moderation effects of gender and age on the association between composite measures of socio-economic status and AUDIT dimensions.

	AUDIT-C			AUDIT-Harm			AUDIT-Dependence		
	β	95%CI	<i>p</i>	β	95%CI	<i>p</i>	β	95%CI	<i>p</i>
Intercept (Ref: male)	5.1	4.95 to 5.25	<0.001	0.47	0.38 to 0.53	<0.001	-0.03	-0.08 to 0.02	0.249
Gender	-1.02	-1.23 to -0.80	<0.001	-0.23	-0.36 to -0.10	0.001	0.03	-0.05 to 0.10	0.444
Composite score	-0.11	-0.14 to -0.08	<0.001	0.04	0.02 to 0.06	<0.001	0.06	0.05 to 0.07	<0.001
Gender x Composite score	<0.01	-0.05 to 0.04	0.834	<0.01	-0.03 to 0.03	0.983	-0.03	-0.04 to -0.01	0.001
Intercept (Ref: 16–24)	4.91	4.55 to 5.26	<0.001	1.02	0.8 to 1.24	<0.001	-0.02	-0.15 to 0.10	0.730
Aged 25–34	-0.7	-1.16 to -0.25	0.003	-0.65	-0.93 to -0.36	<0.001	0.04	-0.13 to 0.20	0.669
Aged 35–44	-0.57	-1.00 to -0.13	0.012	-0.84	-1.11 to -0.56	<0.001	-0.07	-0.22 to 0.09	0.408
Aged 45–54	-0.42	-0.85 to 0.01	0.055	-0.85	-1.11 to -0.59	<0.001	-0.04	-0.19 to 0.11	0.585
Aged 55–64	-0.25	-0.69 to 0.18	0.257	-0.75	-1.02 to -0.48	<0.001	-0.03	-0.18 to 0.12	0.716
Aged 65+	-0.23	-0.65 to 0.19	0.278	-0.74	-1.00 to -0.48	<0.001	0.01	-0.14 to 0.16	0.933
Composite score	-0.01	-0.07 to 0.06	0.854	0.05	<0.01 to 0.09	0.035	0.1	0.07 to 0.12	<0.001
Aged 25–34 x Composite score	<0.01	-0.09 to 0.09	0.971	0.01	-0.04 to 0.07	0.603	-0.04	-0.07 to <0.01	0.032
Aged 35–44 x Composite score	-0.02	-0.11 to 0.07	0.699	0.04	-0.01 to 0.10	0.137	-0.03	-0.06 to 0.01	0.103
Aged 45–54 x Composite score	-0.04	-0.13 to 0.04	0.336	0.03	-0.02 to 0.08	0.291	-0.04	-0.07 to -0.01	0.019
Aged 55–64 x Composite score	-0.11	-0.20 to -0.30	0.011	-0.03	-0.08 to 0.02	0.28	-0.06	-0.09 to -0.03	<0.001
Aged 65+ x Composite score	-0.25	-0.33 to -0.17	<0.001	-0.06	-0.11 to -0.01	0.011	-0.08	-0.11 to -0.06	<0.001

Note: Data were weighted to match the population in England; To correct for multiple comparisons the False Discovery Rate was applied (Benjamini and Yekutieli, 2001)

doi:10.1371/journal.pone.0160666.t009

shown to be more prevalent in younger age groups [67, 68]. The moderation effect of age may also be a methodological artefact. Older drinkers from lower SES groups could have been disproportionately excluded from the study as they are homeless or based in residential care/hospitals [69]. At the same time, research suggests that those from lower SES die from alcohol-related disorders at a younger age, and so older age groups may reflect the ‘healthier’ drinkers from lower SES groups [18].

This study has several strengths including its large sample size, use of multiple measures of SES and use of a validated measure of alcohol consumption and alcohol-related problems [45]. However, as with all cross-sectional surveys, caution should be taken when assigning cause and effect. It may be the case that SES has a direct influence on drinking behaviour or that drinking behaviour has an effect on SES measures. For example, those who experience greater alcohol problems may be more likely to become unemployed. Self-report measures are also susceptible to recall bias. This paper also makes the assumption that a measure of harmful alcohol use equates to actual alcohol-related harm. There is evidence to suggest that AUDIT scores are predictive of general health and disability, and that the AUDIT does as well as laboratory markers at predicting consumption [70]. The findings are also consistent with previous studies which have used objective clinical measures [19]. Another limitation is that moderation effects were only assessed using the composite score. However, this was found to be a reliable measure of SES and recognised the multifaceted nature of the phenomenon [21, 44]. Finally, although this paper assessed a wide range of SES measures which reflect those used previously [71]; the measures did not fully address the social capital aspect of SES [71, 72]. This is something which may require further consideration, as family and friend networks are associated with health outcomes [73].

In summary, we confirmed the generalisability of the Alcohol Harm Paradox across different measures of SES, but those different measures appear to influence whether it is observed as

a linear trend across SES groups or a phenomenon associated particularly with the most disadvantaged. The paradox also appears to be more concentrated in men and younger age groups.

Supporting Information

S1 Table. Association between individual SES measures and the 10-items of the AUDIT. (PDF)

Author Contributions

Conceived and designed the experiments: EB SM JB RW.

Analyzed the data: EB.

Wrote the paper: EB.

All other authors commented on this first draft and contributed to the final draft: CA AB PM EK JH.

References

1. Ellison J. Reducing harmful drinking.: Department of Health; 2013. Available: <https://www.gov.uk/government/policies/reducing-harmful-drinking>.
2. Milton A. The evidence base for alcohol guidelines: Supplementary written evidence submitted by the Department of Health 2012. Available: <http://www.publications.parliament.uk/pa/cm201012/cmselect/cmsctech/writev/1536/ag00a.htm>.
3. Organization WH. Global status report on alcohol and health: World Health Organization; 2014.
4. Institute of Alcohol Studies. Alcohol, Health inequalities and the harm paradox: why some groups face greater problems despite consuming less alcohol 2014. Available: <http://www.ias.org.uk/uploads/pdf/IAS%20reports/IAS%20report%20Alcohol%20and%20health%20inequalities%20FULL.pdf>.
5. Alcohol Research UK. Alcohol Research UK Final Report Understanding the alcohol harm paradox in order to focus the development of interventions 2015. Available: <http://www.cph.org.uk/wp-content/uploads/2015/03/alcohol-harm-paradox-final-report.pdf>.
6. Fone DL, Farewell DM, White J, Lyons RA, Dunstan FD. Socioeconomic patterning of excess alcohol consumption and binge drinking: a cross-sectional study of multilevel associations with neighbourhood deprivation. *BMJ Open*. 2013; 3(4). doi: [10.1136/bmjopen-2012-002337](https://doi.org/10.1136/bmjopen-2012-002337)
7. Siegler V, Al-Hamad A, Johnson B, Wells C, Sheron N. Social inequalities in alcohol-related adult mortality by National Statistics Socio-economic Classification, England and Wales, 2001–03 2011. Available: <http://www.ons.gov.uk/ons/rel/hsg/health-statistics-quarterly/no-50-summer-2011/social-inequalities-in-alcohol-related-adult-mortality-by-national-statistics-socio-economic-classification-england-and-wales-2001-03.pdf>.
8. World Health Organization. Global status report on alcohol and health-2014: World Health Organization; 2014.
9. Health and Social Care Information Centre. Statistics on Alcohol: England, 2013 2013. Available: <http://www.hscic.gov.uk/catalogue/PUB10932/alc-eng-2013-rep.pdf>.
10. Department of Health. Written evidence from the Department of Health for the Health Select Committee. 2012. Available: <http://www.parliament.uk/documents/commons-committees/Health/Writtenevidencebyoralwitnesses.pdf>.
11. Erskine S, Maheswaran R, Pearson T, Gleeson D. Socioeconomic deprivation, urban-rural location and alcohol-related mortality in England and Wales. *BMC Public Health*. 2010; 10(1):99.
12. Breakwell C, Baker A, Griffiths C, Jackson G, Fegan G, Marshall D. Trends and geographical variations in alcohol-related deaths in the United Kingdom, 1991–2004. *Health Statistics Quarterly*. 2007; 33:6–24. PMID: [17373379](https://pubmed.ncbi.nlm.nih.gov/17373379/)
13. Deacon L, Morleo M, Hannon KL, Cook PA, Tocque K, Perkins C, et al. Alcohol consumption: segmentation series report 2. North West Public Health Observatory, Centre for Public Health Research Directorate, Liverpool John Moores University, Liverpool. 2010.
14. Smith CL, Clay PM. Measuring subjective and objective well-being: analyses from five marine commercial fisheries. *Human Organization*. 2010; 69(2):158–68.

15. Smith GW, Shevlin M, Murphy J, Houston JE. An assessment of the demographic and clinical correlates of the dimensions of alcohol use behaviour. *Alcohol and alcoholism* (Oxford, Oxfordshire). 2010; 45(6):563–72. Epub 2010/09/30. PMID: [20876219](#).
16. Romelsjö A, Lundberg M. The changes in the social class distribution of moderate and high alcohol consumption and of alcohol-related disabilities over time in Stockholm County and in Sweden. *Addiction* (Abingdon, England). 1996; 91(9):1307–24.
17. Makela P, Keskimäki I, Koskinen S. What underlies the high alcohol related mortality of the disadvantaged: high morbidity or poor survival? *Journal of epidemiology and community health*. 2003; 57(12):981–6. Epub 2003/12/04. PMID: [14652266](#); PubMed Central PMCID: PMC1732346.
18. Mäkelä P, Paljärvi T. Do consequences of a given pattern of drinking vary by socioeconomic status? A mortality and hospitalisation follow-up for alcohol-related causes of the Finnish Drinking Habits Surveys. *Journal of epidemiology and community health*. 2008; 62(8):728–33. doi: [10.1136/jech.2007.065672](#) PMID: [18621959](#)
19. Probst C, Roerecke M, Behrendt S, Rehm J. Socioeconomic differences in alcohol-attributable mortality compared with all-cause mortality: a systematic review and meta-analysis. *International journal of epidemiology*. 2014; 43(4):1314–27. doi: [10.1093/ije/dyu043](#) PMID: [24618188](#)
20. Jones L, Bates G, McCoy E, Bellis MA. Relationship between alcohol-attributable disease and socioeconomic status, and the role of alcohol consumption in this relationship: a systematic review and meta-analysis. *BMC Public Health*. 2015; 15(1):400.
21. Organisation for Economic Co-operation and Development Handbook on constructing composite indicators: Methodology and user guide. Paris: OECD Publishing; 2008.
22. Ram R. Composite indices of physical quality of life, basic needs fulfilment, and income: A principal component representation. *Journal of Development Economics*. 1982; 11(2):227–47.
23. Duncan GJ, Daly MC, McDonough P, Williams DR. Optimal Indicators of Socioeconomic Status for Health Research. *American Journal of Public Health*. 2002; 92(7):1151–7. doi: [10.2105/AJPH.92.7.1151](#) PMID: [12084700](#)
24. Strong M, Pearson T, MacNab YC, Maheswaran R. Mapping gender variation in the spatial pattern of alcohol-related mortality: a Bayesian analysis using data from South Yorkshire, United Kingdom. *Spatial and spatio-temporal epidemiology*. 2012; 3(2):141–9. doi: [10.1016/j.sste.2012.04.007](#) PMID: [22682440](#)
25. Temple M, Fillmore K, Hartka E, Johnstone B, Leino E, Motoyoshi M. The Collaborative Alcohol-Related Longitudinal Project. A meta-analysis of change in marital and employment status as predictors of alcohol consumption on a typical occasion. *Br J Addiction*. 1991; 86:1269–81.
26. Marmot M. Inequality, deprivation and alcohol use. *Addiction* (Abingdon, England). 1997; 92 Suppl 1: S13–20. Epub 1997/03/01. PMID: [9167283](#).
27. Batty GD, Bhaskar A, Emslie C, Benzeval M, Der G, Lewars H, et al. Association of life course socioeconomic disadvantage with future problem drinking and heavy drinking: gender differentials in the west of Scotland. *International journal of public health*. 2012; 57(1):119–26. Epub 2011/07/05. doi: [10.1007/s00038-011-0270-8](#) PMID: [21725860](#).
28. Grittner U, Kuntsche S, Graham K, Bloomfield K. Social inequalities and gender differences in the experience of alcohol-related problems. *Alcohol and alcoholism* (Oxford, Oxfordshire). 2012; 47(5):597–605. Epub 2012/05/01. doi: [10.1093/alcalc/ags040](#) PMID: [22542707](#); PubMed Central PMCID: PMC3417684.
29. Bloomfield K, Grittner U, Kramer S, Gmel G. Social inequalities in alcohol consumption and alcohol-related problems in the study countries of the EU concerted action 'Gender, Culture and Alcohol Problems: a Multi-national Study'. *Alcohol and alcoholism* (Oxford, Oxfordshire) Supplement. 2006; 41(1): i26–36. Epub 2006/10/13. PMID: [17030500](#).
30. Allen JP, Litten RZ, Fertig JB, Babor T. A Review of Research on the Alcohol Use Disorders Identification Test (AUDIT). *Alcoholism: Clinical and Experimental Research*. 1997; 21(4):613–9.
31. Cook S, De Stavola B, Saburova L, Kiryanov N, Vasiljev M, McCambridge J, et al. Socio-demographic predictors of dimensions of the AUDIT score in a population sample of working-age men in Izhevsk, Russia. *Alcohol and alcoholism* (Oxford, Oxfordshire). 2011; 46(6):702–8. Epub 2011/07/06. doi: [10.1093/alcalc/agr076](#) PMID: [21727097](#); PubMed Central PMCID: PMC3196365.
32. Caamaño-Isorna F, Corral M, Parada M, Cadaveira F. Factors associated with risky consumption and heavy episodic drinking among Spanish university students. *Journal of Studies on Alcohol and Drugs*. 2008; 69(2):308–12. PMID: [18299773](#)
33. Inder KJ, Handley TE, Fitzgerald M, Lewin TJ, Coleman C, Perkins D, et al. Individual and district-level predictors of alcohol use: cross sectional findings from a rural mental health survey in Australia. *BMC public health*. 2012; 12(1):586.

34. Office for National Statistics. Lives lost to alcohol: Does your occupation matter? 2015.
35. Mundt MP, Zakletskaia LI. Prevention for college students who suffer alcohol-induced blackouts could deter high-cost emergency department visits. *Health Affairs*. 2012; 31(4):863–70. doi: [10.1377/hlthaff.2010.1140](https://doi.org/10.1377/hlthaff.2010.1140) PMID: [22422503](https://pubmed.ncbi.nlm.nih.gov/22422503/)
36. Mundt MP, Zakletskaia LI, Brown DD, Fleming MF. Alcohol-induced memory blackouts as an indicator of injury risk among college drinkers. *Injury prevention*. 2012; 18(1):44–9. doi: [10.1136/ip.2011.031724](https://doi.org/10.1136/ip.2011.031724) PMID: [21708813](https://pubmed.ncbi.nlm.nih.gov/21708813/)
37. Lewer D, Meier P, Beard E, Kaner E. Patterns of very heavy drinking and the alcohol harm paradox: a cross-sectional study in England. Under preparation.
38. Beard E, Brown J, West R, Acton C, Brennan A, Drummond C, et al. Protocol for a national monthly survey of alcohol use in England with 6-month follow-up: 'The Alcohol Toolkit Study'. *BMC public health*. 2015; 15(1):230.
39. Von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Preventive medicine*. 2007; 45(4):247–51. PMID: [17950122](https://pubmed.ncbi.nlm.nih.gov/17950122/)
40. Collis D. Social grade: A classification tool—Bite sized through piece 2009. Available: https://www.ipsos-mori.com/DownloadPublication/1285_MediaCT_thoughtpiece_Social_Grade_July09_V3_WEB.pdf.
41. National Statistics Department for Work and Pensions. Households Below Average Income: An Analysis of the Income Distribution 1994/95–2009/10 2011. Available: http://research.dwp.gov.uk/asd/hbai/hbai2010/pdf_files/full_hbai11.pdf.
42. Eachus J, Chan P, Pearson N, Propper C, Smith GD. An additional dimension to health inequalities: disease severity and socioeconomic position. *Journal of epidemiology and community health*. 1999; 53(10):603–11. PMID: [10616672](https://pubmed.ncbi.nlm.nih.gov/10616672/)
43. Galobardes B, Shaw M, Lawlor DA, Lynch JW, Smith GD. Indicators of socioeconomic position (part 1). *Journal of epidemiology and community health*. 2006; 60(1):7–12. PMID: [16361448](https://pubmed.ncbi.nlm.nih.gov/16361448/)
44. Batista-Foguet J, Fortiana J, Currie C, Villalbi J. Socio-economic indexes in surveys for comparisons between countries. *Social Indicators Research*. 2004; 67(3):315–32.
45. Saunders JB, Aasland OG, Babor TF, de la Fuente JR, Grant M. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption—II. *Addiction (Abingdon, England)*. 1993; 88(6):791–804. Epub 1993/06/01. PMID: [8329970](https://pubmed.ncbi.nlm.nih.gov/8329970/).
46. Frank D, DeBenedetti AF, Volk RJ, Williams EC, Kivlahan DR, Bradley KA. Effectiveness of the AUDIT-C as a Screening Test for Alcohol Misuse in Three Race/Ethnic Groups. *Journal of General Internal Medicine*. 2008; 23(6):781–7. doi: [10.1007/s11606-008-0594-0](https://doi.org/10.1007/s11606-008-0594-0). PMC2517893. PMID: [18421511](https://pubmed.ncbi.nlm.nih.gov/18421511/)
47. Honaker J, King G, Blackwell M, Blackwell MM. Package 'Amelia'. Version; 2010.
48. Little RJ, Schenker N. Missing data. *Handbook of statistical modeling for the social and behavioral sciences*: Springer; 1995. p. 39–75.
49. Graham JW, Olchowski AE, Gilreath TD. How many imputations are really needed? Some practical clarifications of multiple imputation theory. *Prevention Science*. 2007; 8(3):206–13. PMID: [17549635](https://pubmed.ncbi.nlm.nih.gov/17549635/)
50. Rubin DB. Multiple imputation after 18+ years. *Journal of the American Statistical Association*. 1996; 91(434):473–89.
51. Husson F, Josse J, Le S, Mazet J, Husson MF. Package 'FactoMineR'. 2014.
52. Ram R. Composite indices of physical quality of life, basic needs fulfilment, and income: A 'principal component' representation. *Journal of Development Economics*. 1982; 11(2):227–47.
53. Lumley T. Analysis of complex survey samples. *Journal of Statistical Software*. 2004; 9(1):1–19.
54. House of Commons Debates. 'Social Security Benefits: Alcoholic Drinks and Drugs' 2013. Available: http://www.publications.parliament.uk/pa/cm201314/cmhansrd/cm130625/text/130625w0005.htm#130625w0005.htm_wqn2.
55. Erskine S, Maheswaran R, Pearson T, Gleeson D. Socioeconomic deprivation, urban-rural location and alcohol-related mortality in England and Wales. *BMC Public Health*. 2010; 10(1):1–8. doi: [10.1186/1471-2458-10-99](https://doi.org/10.1186/1471-2458-10-99)
56. Beard E, Brown J, Michie S, West R. Regional differences in smoking and alcohol consumption in England: A national survey. under preparation.
57. Choi H, Marks NF. Socioeconomic Status, Marital Status Continuity and Change, Marital Conflict, and Mortality. *Journal of aging and health*. 2011; 23(4):714–42. doi: [10.1177/0898264310393339](https://doi.org/10.1177/0898264310393339). PMC3084901. PMID: [21273502](https://pubmed.ncbi.nlm.nih.gov/21273502/)

58. Foxcroft DR, Ireland D, Lister-Sharp DJ, Lowe G, Breen R. Longer-term primary prevention for alcohol misuse in young people: A systematic review. *Addiction* (Abingdon, England). 2003; 98(4):397–411.
59. Holmes J, Meng Y, Meier PS, Brennan A, Angus C, Campbell-Burton A, et al. Effects of minimum unit pricing for alcohol on different income and socioeconomic groups: a modelling study. *Lancet*. 2014; 383(9929):1655–64. doi: [10.1016/S0140-6736\(13\)62417-4](https://doi.org/10.1016/S0140-6736(13)62417-4). PMC4018486. PMID: [24522180](https://pubmed.ncbi.nlm.nih.gov/24522180/)
60. Kendler KS, Myers J, Prescott CA. Sex differences in the relationship between social support and risk for major depression: a longitudinal study of opposite-sex twin pairs. *American Journal of Psychiatry*. 2005; 162(2):250–6. PMID: [15677587](https://pubmed.ncbi.nlm.nih.gov/15677587/)
61. Lyons AC, Willott SA. Alcohol consumption, gender identities and women's changing social positions. *Sex roles*. 2008; 59(9–10):694–712.
62. Andreuccetti G, Carvalho HB, Ye Y, Bond J, Monteiro M, Borges G, et al. Does beverage type and drinking context matter in an alcohol-related injury? Evidence from emergency department patients in Latin America. *Drug and Alcohol Dependence*. 2014; 137(0):90–7. <http://dx.doi.org/10.1016/j.drugalcdep.2014.01.010>.
63. Janssen E. Assessing the ties of socioeconomic background and gender on the frequency and the type of alcoholic beverages consumed by French adolescents. *Journal of Substance Use*. 2014;(0):1–7.
64. Chassin L, Pitts SC, Prost J. Binge drinking trajectories from adolescence to emerging adulthood in a high-risk sample: predictors and substance abuse outcomes. *Journal of consulting and clinical psychology*. 2002; 70(1):67. PMID: [11860058](https://pubmed.ncbi.nlm.nih.gov/11860058/)
65. Naimi TS, Brewer RD, Mokdad A, Denny C, Serdula MK, Marks JS. Binge drinking among US adults. *Jama*. 2003; 289(1):70–5. PMID: [12503979](https://pubmed.ncbi.nlm.nih.gov/12503979/)
66. Buck D, Frosini F. Clustering of unhealthy behaviours over time: implications for policy and practice: Kings Fund; 2012. Available: http://www.kingsfund.org.uk/sites/files/kf/field/field_publication_file/clustering-of-unhealthy-behaviours-over-time-aug-2012.pdf.
67. Jha P, Ranson MK, Nguyen SN, Yach D. Estimates of global and regional smoking prevalence in 1995, by age and sex. *American journal of public health*. 2002; 92(6):1002–6. PMID: [12036796](https://pubmed.ncbi.nlm.nih.gov/12036796/)
68. Mackenzie C, Gekoski W, Knox V. Age, gender, and the underutilization of mental health services: the influence of help-seeking attitudes. *Aging and Mental Health*. 2006; 10(6):574–82. PMID: [17050086](https://pubmed.ncbi.nlm.nih.gov/17050086/)
69. Meier PS, Meng Y, Holmes J, Baumberg B, Purshouse R, Hill-McManus D, et al. Adjusting for unrecorded consumption in survey and per capita sales data: quantification of impact on gender- and age-specific alcohol-attributable fractions for oral and pharyngeal cancers in Great Britain. *Alcohol and Alcoholism*. 2013; 48(2):241–9. PMID: [23345391](https://pubmed.ncbi.nlm.nih.gov/23345391/)
70. Grundy E, Holt G. The socioeconomic status of older adults: How should we measure it in studies of health inequalities? *Journal of epidemiology and community health*. 2001; 55(12):895–904. doi: [10.1136/jech.55.12.895](https://doi.org/10.1136/jech.55.12.895) PMID: [11707484](https://pubmed.ncbi.nlm.nih.gov/11707484/)
71. Shavers VL. Measurement of socioeconomic status in health disparities research. *Journal of the National Medical Association*. 2007; 99(9):1013–23. Epub 2007/10/05. PMID: [17913111](https://pubmed.ncbi.nlm.nih.gov/17913111/); PubMed Central PMCID: PMC2575866.
72. Oakes JM, Rossi PH. The measurement of SES in health research: current practice and steps toward a new approach. *Social science & medicine* (1982). 2003; 56(4):769–84. Epub 2003/02/01. PMID: [12560010](https://pubmed.ncbi.nlm.nih.gov/12560010/).
73. Berkman LF, Glass T. Social integration, social networks, social support, and health. *Social epidemiology*. 2000; 1:137–73.